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Erasure/List Random Coding Error Exponents Are Not Universally Achievable*

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Abstract

We study the problem of universal decoding for unknown discrete memoryless channels in the presence of erasure/list option at the decoder, in the random coding regime. Specifically, we harness a universal version of Forney's classical erasure/list decoder developed in earlier studies, which is based on the competitive minimax methodology, and guarantees universal achievability of a certain fraction of the optimum random coding error exponents. In this paper, we derive an exact single-letter expression for the maximum achievable fraction. Examples are given in which the maximal achievable fraction is strictly less than unity, which imply that, in general, there is no universal erasure/list decoder which achieves the same random coding error exponents as the optimal decoder for a known channel. This is in contrast to the situation in ordinary decoding (without the erasure/list option), where optimum exponents are universally achievable, as is well known. It is also demonstrated that previous lower bounds derived for the maximal achievable fraction are not tight in general.

Index Terms

Universal decoding, error exponents, erasure/list decoding, maximum-likelihood decoding, random coding, generalized likelihood ratio test, channel uncertainty, competitive minimax.

I. Introduction

In many practical situations encountered in coded communication systems, the prevalent channel over which transmission takes place is unknown to the receiver. Typically, the optimal maximum likelihood

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